A Toolkit for Stormwater Asset Management and Funding

US EPA Region 9 Environmental Finance Center (EFC) at Sacramento State
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Introduction

Communities throughout the United States are getting serious about managing stormwater. As an increasing state and national priority, municipalities are investing in systems to provide flood protection and comply with National Pollutant Discharge and Elimination System (NPDES) permits. The US Environmental Protection Agency's Environmental Finance Centers throughout the country are supporting this goal, providing expertise and tools to improve local stormwater management capacity.

The US EPA's Region 9 Environmental Finance Center (EFC) at Sacramento State developed a *stormwater financing toolkit* to assist communities in the process of sustainable stormwater program management and funding. The toolkit guides users in estimating costs for maintaining current assets, ensuring permit compliance, and projecting costs for future new infrastructure. The toolkit also allows for recording data, calculating cost of service, and evaluating stormwater utility rate structures, including an ability-to-pay analysis for residential property owners. The toolkit was assembled as part of direct municipal assistance in the US EPA Region 9 territory and has been tested in real-life planning situations for municipal stormwater. It is intended to be a free tool that helps cities get started to better manage their systems.

Like most analysis and modeling efforts, data collection and integration constitutes the majority of work. In undertaking asset management, utility managers will have to develop or update inventories of their system wide assets. Unit and program cost data will need to be gathered from accounting records and external sources, while property and census data will need to be assembled to estimate key factors that support utility billing systems. The toolkit and this document were developed to guide the user in not just *what* to do, but also *how* to do it and *where* to get necessary data. The document is divided into the following sections:

I. Background
II. Evaluating Program Costs and Evaluating Revenues
III. Toolkit Preview

Section I discusses the needs, challenges, and approaches for funding stormwater programs. Section II describes how asset management can be used to develop and refine stormwater funding programs. It references various spreadsheet-based workbooks that comprise the stormwater funding toolkit. Section III lists each of the toolkit materials and how the items can be assembled to evaluate program costs and potential revenue from stormwater utility fees.

About the EFC at Sacramento State

The EPA Region 9 EFC is operated by the Office of Water Programs (OWP) at California State University, Sacramento (Sacramento State). The Sacramento State EFC assists US EPA Region 9 state and local governments, tribal communities, and non-profits with financial planning, asset management, and data analysis. The EFC also provides critical analytical products that fill gaps for local agencies. The goal of the EFC is to enable these entities to become capable of sustainably funding environmental and public health programs for residents.

I. Background

Throughout the US, municipalities pay for water management and infrastructure in many ways. Traditionally, for water supply systems, revenue from water sales provides funding for operations and maintenance. Wastewater and stormwater services are often funded through connection and use charges, with property owners paying a one-time fee to connect with existing municipal systems and then paying monthly or annual fees based on intensity of use. In some areas of the Western US, designated special districts have jurisdiction to assess residents with "special" fees to pay for services and infrastructure development. Such districts are used extensively in California for many types of activities, dating back to the establishment of authority for irrigations districts in 1887 through the state's Wright Act. For example, two of the largest water supply and management organizations in Southern California, the Metropolitan Water District of Southern California and the Water Replenishment District of Southern California, were formed by legislative edict and subsequent voter approval for special purposes of supply water and managing groundwater recharge.

As municipalities in the US developed in the 19th Century, they first organized water supply and then wastewater management activities to promote public health (Tarr et al. 1984). Stormwater management came late to the plate of municipal duties, as local and federal investments in water treatment and supply were bolstered to solve critical public health challenges (NRC 1984). While Clean Water Act dates to 1948 and 1972, regulations for "non-point" contaminant sources such as stormwater were only brought into the regulatory framework after amendments in 1987. Through these amendments (The Water Quality Act of 1987), federal and state regulators began developing program requirements for key polluters and cities (first larger municipalities and later small- and mid-sized municipalities) to control stormwater runoff. Partly as a result of the relatively recent development of regulations and the continued growth in program duties, funding mechanisms for water and wastewater operations are more established than for stormwater. In western states, funding gaps are common in the stormwater sector (Hanak et al. 2013).

Today, national-level interest continues to grow in building capacity for communities to manage stormwater. This is occurring for a variety of reasons, which differ throughout the country. In some areas, the effects of stormwater on regional water bodies are harming regional economies and recreational assets. Elsewhere, communities look to use green infrastructure to simultaneously address stormwater needs and enhance urban streets and landscapes, with benefits for property values and amenities. In drier parts of the US, communities hope to capitalize on capturing stormwater as a way to enhance increasingly scarce water supplies. For all of these purposes, agencies and national organizations are increasingly recognizing funding gaps that cities face in addressing stormwater management needs (NMSA 2018).

In the absence of dedicated funds for stormwater management, cities pay for stormwater infrastructure and permit compliance by cobbling together funding sources. They draw on general funds, use line-item funding streams such as fees for newly developed land, and work with other municipal departments to fund joint activities. These options pose several challenges. First, using general funds means that stormwater infrastructure competes directly with other services. Second, localities throughout the country have varied and unequal opportunities for raising revenue, resulting in disparities in municipal capacity to establish revenue streams. In California, one of the states in US EPA Region 9, localities face unique constraints in raising revenue, due to a voter-approved 1996 ballot measure (Proposition 218), which requires that local taxes and fees meet certain requirements for expenditures or are approved through popular vote. This was subsequently applied to stormwater through a legal decision. Finally, funding stormwater programs through general fund sources may unevenly disperse the costs of compliance and management. For example, industrial facilities or large commercial building tenants may not pay enough in taxes to address the contributions of runoff from their sites to water quality. Aligning risk and funding contributions is best done by fees based on impervious surface cover, with high-risk land uses such as automotive facilities or industrial sites potentially incurring additional charges.

To stabilize funding, some municipalities implement more dedicated funding streams. Municipal stormwater utility fees and taxes are one approach to assess residents for stormwater costs. Rate structures can be based on a variety of methods that incorporate data for socio-demographic and land use characteristics. Additionally, municipalities often assign connection charges to builders and developers for interconnecting new properties with existing systems. Some residents or businesses might be assessed NPDES-related (permit) inspection fees to pay for stormwater permitting activities. For larger new developments, municipal regulations can even require developers to implement neighborhood or regional stormwater management infrastructure, referred to as green infrastructure (GI), low impact development (LID), best management practices (BMPs), and stormwater capture measures (SCMs).

Municipalities also use other methods to raise revenue for stormwater management. Some re-apportion or leverage funds from other relevant departments. For example, stormwater managers can work with transportation sector managers to implement SCMs near roads and other transit features. Additionally, states such as California rely heavily on voter-approved, general obligation bond funding for water infrastructure planning and development projects (Ajami and Christian-Smith 2013). Several voter-approved proposition measures over the past decade, including Proposition 1 (2014) Proposition 84 (2006), and Proposition 68 (2018) contained funding for stormwater planning and development.

Beyond regional funding, some national-level funding sources support stormwater management. The Clean Water State Revolving Fund from the US EPA offers low-interest loans for, among other activities, stormwater infrastructure improvements and restoration projects. Municipal borrowers identify a source for paying back the loans over time, which can include stormwater utility fees, developer fees, and other fees not directly related to stormwater management (US EPA 2016).

Additionally, innovative revenue sources are being explored or implemented. Stormwater infrastructure improvements can be funded jointly among municipal departments and other agencies. In the city of Long Beach, CA, for instance, the municipality partnered with the California State Department of Transportation to undertake stormwater infrastructure improvements that included a highway corridor. Some commercial or industrial businesses that already comply with stormwater permits are also potential partners for regional projects. Inspirational ideas for new funding sources also come from other resource sectors. The electricity sector, for example has on-bill charges, which are assessed at a fixed rate and used to pay for consistent infrastructure costs such as electricity transmission lines. Additionally, in California, a "public goods" charge is included for all rate-payers, which funds renewable energy research and implementation programs (Quesnel and Ajami 2018).

Other mechanisms allow municipalities to finance some costs of stormwater management with debt-based funding sources. In recent years, several innovative public bond initiatives have emerged that are potentially applicable to stormwater and water management (Stanford et al. 2015, Jacques 2018). For instance, Environmental Impact Bonds (EIBs) are "pay-for-performance" arrangements, where a municipality floats a bond and investors are repaid only when the funded assets yield expected results. In recent years, several municipalities, including Washington, D.C., have used EIBs to fund infrastructure. A related category of environmental-focused bonds are "green" bonds, which are bonds dedicated to climate or environmental purposes. The San Francisco Public Utilities Commission has used several rounds of green bond funding to support water, wastewater, and stormwater infrastructure projects (SFPUC 2017). Finally, through recent clarifications to accounting standards, bond funding can be used to pay for activities that do not generate municipal assets, such as distributed green infrastructure or rebate programs. Note that for all these funding sources, municipalities must have revenue sources to make long-term payments (with interest) for the life of the bond.

The quickly emerging landscape of alternative funding mechanisms for stormwater provides many opportunities for creativity. However, it also generates uncertainty, especially for funding and financing mechanisms with limited track records. Moreover, while financing mechanisms (i.e. loans and bonds) can be useful, they must ultimately be paid back with interest, creating long-term debt obligations. Revenues are always necessary. Municipalities are encouraged to survey all of these options when devising a long-term strategy that supports stormwater programs and new infrastructure in their communities.

II. Evaluating Program Costs and Revenues

Stormwater program management requires assessing current and future costs and identifying potential revenue sources. Asset management is a key process that helps identify and prioritize current and future program costs to support long-term investments. It assists in developing sustainable revenue and assessing financial impacts on communities and municipalities. The Sacramento State EFC used asset management principles in developing guidance materials for municipalities to estimate stormwater program costs and evaluate potential revenue that will be needed to sustain their programs. Asset management, which traditionally involves current and future management of existing assets, can be combined with NPDES permit compliance needs and long-term stormwater management plans (for both water quality and drainage improvements) to capture the suite of services needed in contemporary stormwater programs.

The Sacramento State EFC's approach to developing a sustainable stormwater funding involves a multi-step procedure:

1. Create an asset inventory
2. Define levels of service (LOS) for maintaining assets
3. Estimate program costs for
    a. Operation and maintenance (O&M) of existing assets
    b. Permit compliance activities
    c. Capital & O&M for future new infrastructure
4. Engage stakeholders and solicit input
5. Conduct an ability-to-pay analysis
6. Develop a rate structure
7. Determine remaining funding gaps
8. Recommend additional revenue options

9. Public education and outreach

Each of these steps is described below, with references to various components of the Sacramento State EFC stormwater financing toolkit.

II.A. Creating an Asset Inventory

To assist in estimating a municipality's total stormwater program costs, asset management tools are valuable. Many such tools exist. They all allow municipal stormwater managers to document the process of creating and prioritizing an organized inventory of stormwater infrastructure, which can include gravity mains, detention basins, GI, manholes, and other components. Such tools range from simple tabular templates such as that provided by US EPA (see Figure 1 below) to sophisticated proprietary software databases that can contain built-in cost resources and/or decision making functionality (Figure 2).

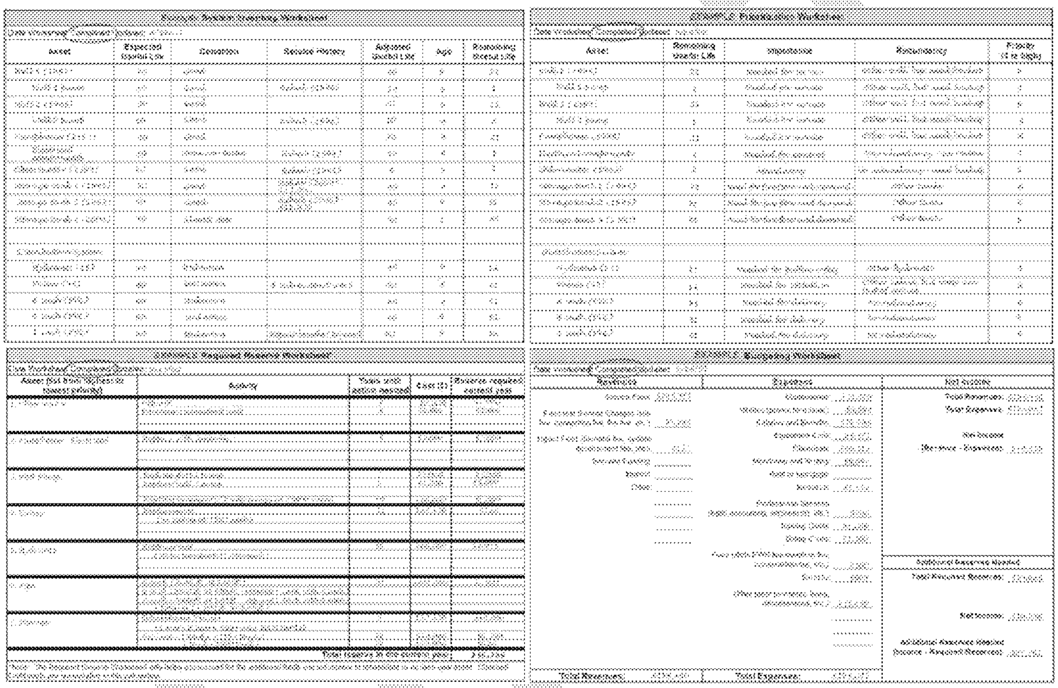

Figure 1. Example of Simple Asset Management Templates (EPA 2003)

The Sacramento State EFC developed an *asset inventory workbook* as part of its asset management toolkit. The asset inventory method followed in the workbook is a synthesis of several documented asset management approaches. In particular, one method was developed by the City of Grand Rapids, Michigan in creating its *Stormwater Asset Management and Capital Improvement Plan* (Grand Rapids 2016). Another useful resource was developed by the US EPA and documented in *Asset Management: A Handbook for Small Water Systems* (US EPA 2003). Of these two, the approach by Grand Rapids for asset prioritization is straightforward and easily adaptable, but it may be too detailed for smaller municipalities. Combining the Grand Rapids mathematical method and elements from the US EPA method, which is easier to follow but lacks details to support decision making, allowed the EFC to develop a robust and user-friendly workbook template.

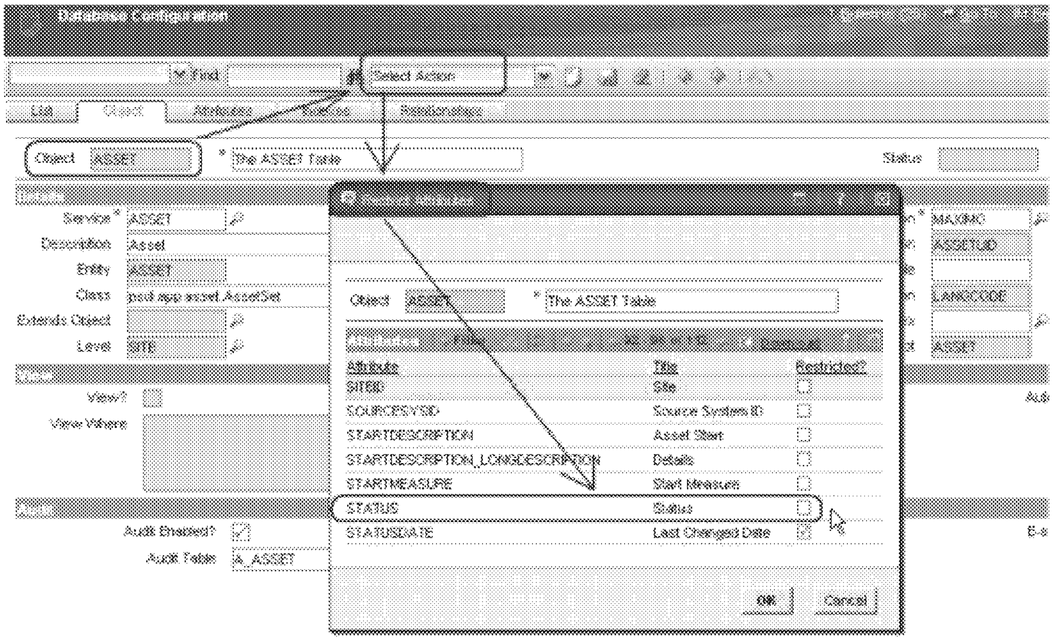

Figure 2. Example of Comprehensive Asset Management Software (IBM 2018)

The Sacramento State EFC asset inventory workbook stores common asset characteristics, such as asset type, material, age, and estimated expected life (EEL). These characteristics are used to calculate two factors that contribute to a prioritization rank for planning maintenance and replacements: the probability of failure (POF) and the consequence of failure (COF). The POF estimates the likelihood of asset failure compared to other assets, based on an assessment of the asset's age and condition. The COF estimates the impacts of a component outage, based on knowledge of the difficulty and cost for replacement, as well as impact on other community assets, services, and resources. The asset inventory workbook estimates these POF and COF scores to evaluate an overall risk of failure. The overall risk, then, helps determine and prioritize assets for repair or replacement in current and future years, based on an identified *Level of Service* (LOS), as described below.

II.B. Defining Level of Service

Level of service (LOS) is a measure of the quality or expected reliability that must be provided by an agency to meet a community's basic needs and expectations (Grand Rapids 2016). It describes the extent of O&M activities performed for assets. LOS can have varying degrees of scope and scale. An LOS can meet maintenance and repair needs as they arise (a reactive level), or more proactively undertake system maintenance and renewal activities prior to failures (a preventative level). In the end, a selected LOS must meet community expectations for performance and equity.

The Sacramento State EFC method uses a LOS approach similar to that used by Grant Rapids, categorizing O&M activities to help distinguish and define multiple LOSs. Defining multiple LOSs allows municipalities to compare options and solicit stakeholder input in determining how to best serve the community and make good on investments. The O&M categories are:

- *Inspections*, including activities such as visual assessments and in-pipe inspections with cameras,

- *Preventative maintenance* actions performed to increase the effective life of the asset or improve its performance, such as patching cracks in a pipe or removing accumulated sediment,
- *Corrective maintenance* to fix a problem with an asset, including repairs and partial replacement, but not considering full replacement of assets, and
- *System renewal*, or the complete removal and replacement of assets.

The Sacramento State EFC method establishes a *baseline LOS* intended to identify O&M activities currently performed (or to be performed). An example of the baseline LOS defined by Grand Rapids is provided in Table 1. (Note that although Grand Rapids does not include GI, LID, BMPs or SCMs, the Sacramento State EFC method provides means for including these assets). The baseline LOS represents a minimum service effort needed based on a limited O&M budget and usually prior to an asset management plan. There are no scheduled preventative maintenance operations or system renewals planned. Instead, assets are replaced or repaired as they fail.

Table 1. Baseline Level of Service Definition (Grand Rapids, 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal
Gravity Mains	---	Respond to failures and complaints for all sewer components.	---	---
Force Mains	Visual inspection every 2 weeks during pump station inspection.	---	---	---
Catch Basins	---	Clean 2500 annually and perform corrective maintenance.	---	---
Outfalls	---		---	---
Detention Basins	---	---	---	---
Culverts	---	Clean debris and perform corrective maintenance.	---	---

Successive, more advanced LOSs will increase the type and frequency of inspections and maintenance, and accelerate the process of replacing assets. More proactive (higher) LOSs would replace assets before their end-of-life and reduce the risk of undesired failures and outages. A higher LOS is typically more expensive, initially, from a maintenance cost perspective, though it may be more cost-effective when considering total life-cycle costs. Table 2 and Table 3 show examples of higher levels of service considered by Grand Rapids. The LOS in Table 2, which is more proactive than the baseline, shows that every asset type has a plan for system renewal and inspection. Most asset types also have plans for corrective and preventative maintenance of components.

Table 2. Moderate Level of Service Definition (Grand Rapids 2016)

Asset	Inspection	Corrective Maintenance	Preventative Maintenance	System Renewal
Gravity Mains	PACP[1] CCTV[2] inspect pipes greater than 75 years old over 10-year period.	Replace 15% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% of inspected sewers over 10 years.	Replace every 150 years.
Force Mains	Visual inspection every 2 weeks during pump station inspection. PACP CCTV inspect every 15 years.	---	---	Replace every 100 years.
Catch Basins	Clean and inspect 25% annually (Approx. 4264). Record and monitor debris levels for cleaning prioritization.	Clean 2500 annually and perform corrective maintenance.	Replace 15% of assets that have reached end of EEL over 10 years.	Replace every 100 years.
Outfalls	Inspect all outfall points every 5 years per MS4[3] requirements.	Replace top 10% by POF each cycle.	Stabilize bank and erosion control at 5% of assets each cycle.	Replace every 150 years.
Detention Basins	Complete site inspection 3 times annually including routine maintenance.	---	---	Facility renovation every 100 years. Includes regrading, seeding, renew inlet/outlet structures.
Culverts	CCTV/walk/inspect 50% of culverts annually.	Replace/rehabilitate top 5% by POF.	Clean 20% of all assets annually.	Replace every 150 years.

[1] *Pipeline Assessment Certification Program*
[2] *Closed-Circuit Television*
[3] *Municipal Separate Storm Sewer System*

The Sacramento State EFC method suggests establishing the baseline LOS as the O&M activities that are currently performed. Defining successive LOSs, however, can be a difficult, even daunting, task. The POF and COF scores determined from the asset inventory workbook provide a useful starting point. Recall that the POF estimates how likely an asset is to fail compared with other assets, based on an assessment of the asset's age and condition, while the COF estimates the impacts of a component outage based on knowledge of the difficulty and cost for replacement, as well as impact on other community assets, resources, and services. The POF and COF can be combined through a simple table or matrix, as shown in Figure 3 to qualitatively categorize the risk associated with a component's failure and compare risks among assets. The risk categories are:

- High COF and high POF – high risk
- High COF and low POF – moderately high risk (due to high COF)

- Low COF and high POF – moderately low risk (due to low COF)
- Low COF and low POF – low risk

Table 3. Advanced Level of Service Definition (Grand Rapids, 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal
Gravity Mains	PACP CCTV inspect pipes greater than 50 years old over 10-year period.	Replace 30% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% of inspected sewers over 10 years. Clean 20% of all assets annually.	Replace every 125 years.
Force Mains	Visual inspection every 2 weeks during pump station inspection. PACP CCTV inspect every 10 years.			Replace every 100 years.
Catch Basins	Clean and inspect 35% annually (Approx. 5969). Record and monitor debris levels for cleaning prioritization.	Replace 30% of assets that have reached end of EEL over 10 years.	Perform rehabilitation to extend EEL for 10% of inspected catch basins over 10 years.	Replace every 75 years.
Outfalls	Inspect all outfall points every 3 years to satisfy MS4 requirements.	Replace top 10% by POF each cycle.	Stabilize bank and erosion control at 10% of assets each cycle.	Replace every 125 years.
Detention Basins	Complete site inspection 3 times annually including routine maintenance.			Facility renovation every 75 years. Includes regrading, seeding, renew inlet/outlet structures.
Culverts	CCTV/walk/inspect 50% of culverts annually.	Replace/rehabilitate top 10% by POF.		Replace every 125 years.

Assets falling into higher risk categories should be given higher priority for O&M activities. The matrix (categories) can be used to help define LOS options beyond the baseline. The Sacramento State EFC recommends defining a *high LOS* and a *moderate LOS* (based on improvements to the baseline) as described below.

A high LOS plan is intended to both reduce failure risk and improve long-term cost optimization over the baseline LOS. In particular, the goal of a high LOS is to reduce failure of assets with high consequences or probabilities of failure, while maximizing the effective life of low risk assets. To do this, a schedule is developed that: 1) prioritizes replacement of assets with high consequences or probabilities of failure (quadrants I, II, and III in Figure 3), and 2) establishes inspection and preventive maintenance activities for all assets to reduce failure risk before scheduled replacement.

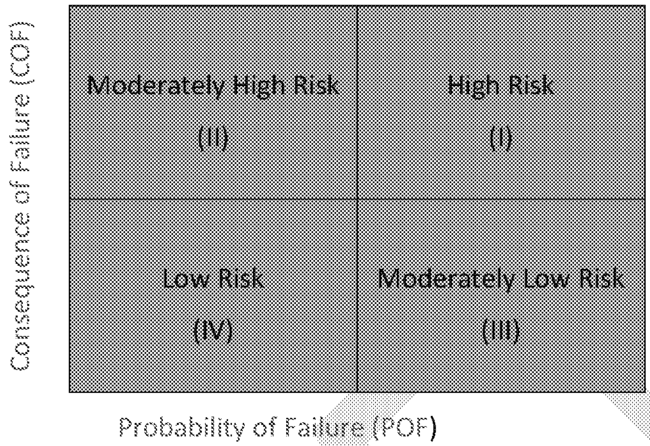

Figure 3. Matrix of Asset Risk Categories based on COF and POF

For high LOS plans, the following steps are recommended:

1. *Establish System Renewal Schedules*
High risk assets (i.e., those in quadrant 1 of Figure 3) should receive the highest priority for replacement due to high probability and consequence of failure. Moderately high risk assets (quadrant II) should have the next highest priority for replacement, as their consequence of failure is high. Assuming a high LOS follows a proactive program that seeks to minimize failures, moderately low risk assets (quadrant III) would be next on the schedule for replacement because, although the consequence of failure is relatively low, the likelihood is high. Low risk assets (quadrant IV) can be scheduled for replacement at the end of their expected effective life.
2. *Establish Inspection Schedules*
Once a system renewal timeline is established, determine an inspection timeline necessary to prevent asset failure until the asset is scheduled for replacement. The inspection schedule will be more frequent than in the baseline LOS, and more types of inspection activities may be necessary. It may be most efficient to schedule inspections according to asset categories, where a percentage of the assets within the same category are inspected on the same frequency, and rotated across time. For example, if there are 10,000 drain inlets and they predominantly have a low risk of failure, a reasonable inspection schedule might be 1,000 drain inlets per year, with all drain inlets inspected on a ten-year cycle.
3. *Establish Preventative Maintenance Schedules*
Similar to inspection schedules, establish preventative and corrective maintenance schedules to prevent failure until the asset's scheduled time of renewal. This will likely be more frequent than that for the baseline LOS and may include more types of maintenance activities. A good source for determining maintenance activities and frequencies would be manufacturer recommendations.

A moderate LOS plan is intended as an improvement upon the baseline LOS, but not to the extent of the high LOS. The goal of the moderate LOS is to reduce corrective action and failure of assets with high consequences of failure and delay failure of assets with low consequences. To do this, a schedule is developed to: 1) prioritize replacement of all assets with high consequences of failures, and 2) establish inspection and preventive maintenance activities for all assets to reduce the probability of failure. For moderate LOS plans, the following steps are recommended:

1. *Establish a System Renewal Schedule*
   As with the high LOS, high risk assets (quadrant I) should have the highest priority for replacement, moderately high risk assets (quadrant II) should have second priority, and low risk assets (quadrant IV) can be inspected and maintained with replacement planned for the end of their expected effective life. Moderately low risk assets (quadrant III) can merely be inspected and maintained to maximize their effective life, in lieu of making their replacement a priority. Although their probability of failure is high, the consequence is relatively low, justifying delay of replacement until failure occurs. An increase in inspections of these assets will help minimize costs and consequences.
2. *Increase the Frequency of Inspections and Maintenance used for the Baseline LOS*
   Inspections and preventative maintenance have a low cost relative to corrective maintenance or system renewal. Increasing these activities can reduce asset failure rates and prolong asset life.

II.C. Estimating Costs

The Sacramento State EFC method for estimating costs associated with municipal stormwater programs breaks expenses into the following three groups:

- O&M of existing assets
- Permit compliance
- Future buildout

Typical expenses associated with each of these are summarized below.

Costs for O&M of Existing Assets

Costs associated with O&M of the existing infrastructure system, including both grey (drainage) and green (retention and infiltration) assets, must be estimated. The asset inventory and LOS drive the cost estimates. Presumably existing costs will represent the existing (baseline) LOS, while future costs will depend on the desired future LOS, including inflation estimates.

Data for these estimates can originate from a number of sources. For instance, a municipal stormwater management department may have records of the costs associated with the LOS activities. Existing engineering cost guides such as *RS Means*[1] provide unit values to estimate costs through bottom-up approaches. Data for unit and fixed costs of various materials and labor can come from similar engineering projects. For instance, other municipal departments may have average costs for excavating soil, ripping up streets to install or replace pipes, or hire contractors to conduct routine inspections. Nearby municipalities, too, may have data from similar projects that helps estimate costs for engineering and

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[1] See *RS Means Data Online* or the cost pricing publications. https://www.rsmeans.com/products/online.aspx

planning activities in the region. In 2017, the American Society of Civil Engineers published a handbook, written by experts, with costs for building and maintaining green infrastructure (Clary and Piza 2017). In 2019, the Sacramento State EFC will publish a guide on benefit-cost assessments for stormwater program management, along with a survey from existing sources of available data for permit compliance and infrastructure costs in California and elsewhere.

Grand Rapids (2016) provides a good example for how to organize expenses associated with O&M activities for existing assets. Table 4 shows costs associated with their baseline LOS (defined in Table 1), while Tables 5, 6, and 7 show the higher costs associated with more frequent program activities and system renewal actions (i.e., the higher LOSs presented in Table 2 and Table 3). Comparing the cost estimates for several LOS scenarios allows utility managers to see opportunities and tradeoffs in the aggressiveness of maintenance and associated costs.

Note that the costs presented in Table 4 through Table 7 are considered "Year 1", or current costs. Costs for future years can be projected by applying inflation factors. The Sacramento State EFC toolkit includes worksheets for documenting and calculating the O&M activities and associated costs.

Table 4. Baseline LOS Annual Cost (Grand Rapids 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal	Total
Gravity Mains	$0	$200,000	$0	$1,537,000	$1,737,000
Force Mains	Cost is associated with pump station inspections	$0	$0	$0	$0
Catch Basins	$0	$600,000	$0	$0	$600,000
Outfalls	$0	$0	$0	$0	$0
Detention Basins	$0	$0	$0	$0	$0
Culverts	$0	$20,000	$0	$0	$20,000
Subtotal of Asset Classes	***$0***	***$820,000***	***$0***	***$1,537,000***	***$2,357,000***
O&M (inspection, corrective and preventative maintenance)					$820,000
Capital Renewal (system renewal)					$1,537,000
Total					**$2,357,000**

Table 5. LOS C Annual Cost (Grand Rapids 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal	Total
Gravity Mains	$110,000	$299,000	$647,000	$2,439,000	$3,495,000
Force Mains	$200			$1,000	$1,200
Catch Basins	$639,000	$24,000	$14,000	$560,000	$1,237,000
Outfalls	$28,000	$66,000	$1,200	$12,000	$107,200
Detention Basins	$6,500			$11,300	$17,800
Culverts	$9,700		$43,000	$11,000	$63,700
Subtotal of asset classes	***$793,400***	***$389,000***	***$705,200***	***$3,034,300***	***$4,921,900***
O&M (inspection, corrective and preventative maintenance)					$1,887,600
Capital Renewal (system renewal)					$3,034,300
Total					**$4,921,900**

Table 6. LOS B Annual Cost (Grand Rapids, 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal	Total
Gravity Mains	$212,000	$598,000	$1,207,000	$ 2,927,000	$4,944,000
Force Mains	$300	$0	$0	$1,400	$1,700
Catch Basins	$894,000	$48,000	$26,000	$746,000	$1,714,000
Outfalls	$47,000	$142,000	$6,000	$14,000	$209,000
Detention Basins	$6,500	$0	$0	$15,000	$21,500
Culverts	$9,700	$86,000	$0	$14,000	$109,700
Subtotal of Asset Classes	***$1,169,500***	***$874,000***	***$1,239,000***	***$3,717,400***	***$6,999,900***
O&M (inspection, corrective and preventative maintenance)					$3,282,500
Capital Renewal (system renewal)					$3,717,400
Total					**$6,999,900**

Table 7. LOS A Annual Cost (Grand Rapids, 2016)

Asset	Inspection	Corrective (Maintenance)	Preventative (Maintenance)	System Renewal	Total
Gravity Mains	$482,000	$996,000	$3,252,000	$8,388,000	$13,118,000
Force Mains	$500	$0	$0	$1,800	$2,300
Catch Basins	$1,276,500	$80,000	$94,000	$1,119,000	$2,569,500
Outfalls	$47,000	$142,000	$27,000	$1,700	$217,700
Detention Basins	$6,500	$0	$0	$22,500	$29,000
Culverts	$19,300	$0	$86,000	$17,000	$122,300
Subtotal of Asset Classes	***$1,831,800***	***$1,218,000***	***$3,459,000***	***$9,550,000***	***$16,058,800***
O&M (inspection, corrective and preventative maintenance)					$6,508,800
Capital Renewal (system renewal)					$9,550,000
Total					**$16,058,800**

Costs for Permit Compliance

Small, medium, and large-sized cities must comply with NPDES permits. Required activities can be categorized according to common, primary elements of NPDES permits. The Sacramento State EFC toolkit categorizes NPDES permit requirements into the following core elements:

1) Construction Site Stormwater Runoff Control
2) Illicit Discharge Detection and Elimination
3) Industrial and Commercial Management
4) Pollution Prevention/Good Housekeeping for Municipal Operations
5) Post Construction Stormwater Management for New/Re-Development
6) Public Education, Outreach, Involvement, and Participation
7) Water Quality Monitoring
8) Overall Stormwater Program Management

In addition, municipal programs must address long-term planning activities required for state-wide trash policy compliance, Total Maximum Daily Load (TMDL) compliance, and watershed management coordination. Costs associated with each of the core permit elements and long-term planning actions must therefore be assessed as well. Typical expenses include administrative and maintenance staff labor, equipment, materials, and, in some cases, contracted services. Once current or recent costs have been determined, costs for future compliance can be estimated using inflation factors.

Note that some permit compliance activities and costs (e.g., good housekeeping for municipal operations) may have already been accounted for under O&M of existing assets. Care should be taken to avoid duplicating costs. Also, some permit required activities, such as those required for TMDL compliance, can qualify as either "long-term planning for permit compliance" or as future buildout costs (the latter is discussed in the next subsection). Municipal planners and managers have discretion in where to claim these expenses, so long as they are not duplicated.

A screen shot of the Sacramento State EFC worksheet for total permit compliance costs is show in Figure 4. Figure 5 shows one of the EFC's permit compliance core element cost worksheets. Grand Rapids (2016) did not include NPDES permit compliance expenses in their financial stormwater plan.

Costs for Future Buildouts

Many municipalities throughout the US are struggling to update existing stormwater systems. In addition, for many, meeting Clean Water Act regulations requires additional infrastructure investments and future system buildouts. Incorporating these costs into an asset management plan means projecting costs into the future based on what municipal leaders, stormwater managers, and regulators deem necessary to meet future goals for water quality and flood mitigation.

The extent of plans for future buildouts varies widely across communities. In some parts of Western North America, municipalities are planning for significant investments in new stormwater infrastructure, both centralized and distributed, for water quality, drainage and even water supply goals. Within US EPA's Region 9, Southern California communities, for instance, have outlined infrastructure investment plans to invest in future urban stormwater systems that meet NPDES requirements, including TMDLs of discharges to receiving waters. Some are planning stormwater capture projects for direct use or groundwater recharge. Yet, in other parts of the region, municipalities have no plans for significant new investments. Thus, future buildout costs may or may not be incorporated in the estimates of future costs.

In estimating costs for future buildouts, cost estimates may be *real* or *nominal*. Real costs are adjusted for inflation, whereby the costs of a project in future years can be directly compared to the cost in a current year. Nominal costs, on the other hand, are not adjusted for inflation and are reported as the amount that must be spent in that year, which can be useful when comparing to revenues. Both are valid methods of reporting financial projections, but detailed descriptions of assumptions are necessary to incorporate into asset management.

There are many other factors and methods for projecting future costs, such as whether to report costs as 1) a total dollar amount, 2) a unit cost (dollar amount per value, such as gallons of runoff captured), or 3) life-cycle costs. A unit cost or life-cycle cost approach can be useful for comparing project values and investments, but can be quite complex.

The Sacramento State EFC toolkit includes a worksheet for documenting costs associated with future buildouts (as well as permit compliance and existing system maintenance), based on real, total dollar costs. Attachment B provides future discussion of projecting future expenses using unit or life-cycle costs.

Assembling Total Costs

Once the costs for each of the municipal stormwater program components (existing and future) are estimated, they can be combined to estimate total annual program costs. The Sacramento State EFC toolkit's *total costs workbook*, where all worksheets for permit compliance, existing asset O&M, and future buildout costs reside, summarizes costs from across the other program elements. Figure 6 shows a screenshot of the Sacramento State EFC *total costs workbook* summary worksheet.

	2018	2019	2020	2021	2
Categories	**Current Annual Costs**	**Yr 1 Costs**	**Yr 2 Costs**	**Yr 3 Costs**	**Yr 4**
O&M of Existing Assets	$126,862	$130,668	$134,588	$138,626	
Permit Compliance	$1,049,398	$1,080,880	$1,113,306	$1,146,705	
Future Buildouts	$3,225,000	$3,644,000	$4,062,000	$17,538,000	$
TOTAL	$4,401,260	$4,855,548	$5,309,894	$18,829,931	$
Yr 2 costs and beyond are based on assumed inflation factor:			3%		
Assumes Current year is:	2018				

Figure 4. Screenshot of the Summary Worksheet in the Sacramento State EFC *total costs workbook*

II.D. Engaging Stakeholders and Soliciting Input

As public servants, municipal stormwater managers have a responsibility to communicate with residents and stakeholders. Even more important, the success of stormwater management depends on public engagement and participation. Public engagement and input throughout the process of stormwater management helps solidify public support in an era when new local taxes and spending are often challenged.

After undertaking internal steps to create an asset inventory and better understand the condition of existing systems, stormwater managers can usefully engage key community groups, municipal leaders, and residents. At this stage, they will have data helpful to communicate with the public but listening is an even more important task for outreach. Utility managers can organize working groups or public meetings to communicate the needs and gaps in current stormwater programs. This helps build support for later activities that may need approval by elected leaders or voters.

Category #	Activities	Current Annual Costs	Yr 1 Costs	Yr 2 Costs	...	Yr 17 Costs	Yr 18 Costs	Yr 19 Costs	Yr 20 Costs
1	Construction Site Stormwater Runoff Control	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
2	Illicit Discharge Detection and Elimination	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
3	Industrial and Commercial Management	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
4	Pollution Prevention/Good Housekeeping for Municipal Operations	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
5	Post Construction Stormwater Management for New/Re-Development	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
6	Public Education, Outreach, Involvement, and Participation	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
7	Water Quality Monitoring	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
8	Overall Stormwater Program Management	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
9	Long-Term Planning (e.g., Trash Amendment, TMDL Compliance, Watershed Management Coordination)	$ -	$ -	$ -	...	$ -	$ -	$ -	$ -
					...				
	Subtotal	$0	$0	$0	...	$0	$0	$0	$0
	Yr 2 costs and beyond are based on assumed inflation factor:	3%							
	Assumes Current year is:	2018							

Figure 5. Screen Shot of the Sacramento State EFC Permit Compliance Costs Summary Worksheet

Water Quality Monitoring

Cost Items	Labor Costs			Miscellaneous Costs				Total Cost		Existing Funding	Funding Source
	# FTE	Salary + Fringe + Accrual	Labor Cost	Units	Cost/Unit	# of Units	Miscellaneous Cost				
Labor - student intern			$ -					$ -			
Labor - stormwater staff			$ -					$ -			
Materials			$ -					$ -			
Equipment			$ -					$ -			
Travel			$ -					$ -			
Regional/State program fees			$ -					$ -			
QAPP/SAP preparation			$ -					$ -			
Sample collection			$ -					$ -			
Sample laboratory analysis			$ -					$ -			
Third party modeling/analysis/reporting			$ -					$ -			
Training			$ -					$ -			
Other:			$ -					$ -			
Totals			$ -				$ -	$ -		$ -	

Typical Activities	**Assumptions and References**
QAPP/SAP preparation	
Sample collection	
Sample laboratory analysis	
Data analysis and reporting	
Fee paid for joint monitoring effort conducted by Watershed Group	

Figure 6. Screen Shot of the Sacramento State EFC Example Worksheet for a Core Permit Compliance Element

Engaging key stakeholders early helps shape the trajectory of rate structures and fees. For instance, in a successful 2018 popular ballot measure for stormwater management in Los Angeles County, county officials formed an advisory group of community leaders and experts that shaped how the funds were to be spent. The measure approved for popular vote by county leaders was highly detailed and documented, including allocations of funds between large regional projects and the many underlying agencies that contribute to the region's permit. The ballot measure's success was rooted in the stakeholder processes that helped build support and demonstrate how municipal agencies would responsibly use the new tax dollars.

II.E. Conducting an Ability-to-Pay Analysis

An Ability-to-Pay Analysis (APA) estimates economic impacts of stormwater fees on residents, businesses, industry, and the municipal government. The US EPA developed an APA methodology to determine fees for maintaining combined sewer systems, which is detailed in *Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development* (US EPA 1997). In 2012, the US EPA Office of Water and Office of Enforcement and Compliance Assurance reevaluated that document and determined the methodology could also be used for separate stormwater and wastewater systems (US EPA 2012). The US EPA APA method, which provides a high-level estimate of APA for residents in a community, is organized as follows:

1. *Estimate the total annual program costs.* In the case of storm water quality and drainage, this is the sum of the permit compliance costs and the costs for maintaining the chosen LOS.
2. *Determine residential share of costs*. This involves calculating the percentage of the total annual program costs attributable to residential users.
3. *Calculate the Cost per household (CPH).* This is done by dividing the residential portion of costs by the number of residences.
4. *Calculate the Residential Indicator* (*RI*). To determine if the CPH would be a reasonable fee to charge the residencies, the EPA developed a term they call the Residential Indicator (RI). The RI is the percentage of MHI that would need to be paid as a fee and is calculated by dividing the CPH by the Median Household Income (MHI).
5. *Identify a value or range of potential fees*. EPA's 1997 guidance states that if the RI is less than one percent, the financial impact will be low. If the RI for a single service (i.e. drinking water, stormwater, or wastewater) is between one and two percent, it is considered mid-range, and over two percent is higher impact. Ultimately, however, these values are assumptions and can be assessed in relation to community conditions and input. In addition, for water utility services, guidance notes that best practices would simultaneously consider the financial impact of water supply, wastewater, and stormwater costs for a household, rather than consider them each singularly, although no clear guidance exists to benchmark the impact of these combined fees (NAPA 2017; EPA 2012). Using the established ranges, if the RI is too large, the project team can reduce the CPH to lower the financial impact. Lowering the CPH could result in a funding gap that would need to be covered by alternative revenue sources. Additional funding sources are discussed below.

The MHI is often based on U.S. Census Bureau data for an entire municipality. Several standard rules-of-thumb exist as benchmarks for affordability, derived from US EPA reports. For instance, total expenditures for water services (water and sewer) of 4% of MHI is often used as a threshold for assessing an affordable rate for a household.

However, using MHI to determine if a proposed fee will cause financial hardship does have drawbacks, and the rule-of-thumb percentages for affordability lack empirical grounding. The MHI for areas within a municipality can vary widely and is not an equitable measure of affordability for lower-income households (USCM 2014). Assistance can be offered to low-income customers in the form of a reduced or waived fee, depending on income level. The utility will have to factor in such revenue losses from low-income assistance programs, potentially charging higher rates for other properties to make up shortfalls.

In fact, using percentage thresholds for spending in relation to city-wide or regional MHI metrics for assessing affordability in setting water rates is coming under more intense critiques among water planners. For instance, recent research identified alternative methods deemed more equitable for assessing affordability, including estimating disposable income of residents in a city based on economic surveys, or judging the cost of water services in relation to hours of minimum wage (Teodoro 2018). These metrics have been applied to water and sewer rates, but not stormwater. Such methods provide useful innovations to the current metrics. They may not, however, be applicable to non-metro areas due to data availability, or be too data intensive for local communities to undertake.

As an alternative the EFC has used US Census data from the 2014 American Community Survey (ACS) to estimate MHI for communities at a more granular level. The ACS reports MHI at the level of census tracts or block groups (as opposed to an entire municipality). There are typically many block groups within a municipality. For estimating fee impacts, a useful method to address the potential disproportionate impacts of fees on low-income communities within a municipality is to estimate fees in relation to the block group(s) with the lowest reported MHI. This addresses some of the issues of low-income impacts, while still making the methods applicable to areas without detailed economic survey data for expenditures. Ultimately, a combination of metrics and community input can be used to judge affordability of any new rates or fees. Guidance on this and other considerations in developing an equitable fee structure is in the next section and in Attachment A.

The Sacramento State EFC toolkit allows for recording and assessing ability-to-pay data. This APA exists in the toolkit's rate structure workbook, which is described in the following section. How to gather and assess APA data is included in that discussion as well.

II.F. Developing a Rate Structure

Once a CPH has been estimated, a preferred rate structure can be developed. The Sacramento State EFC toolkit includes a *rate structure workbook* to be used for developing a rate structure and conducting a fiscal capability analysis. The workbook includes a worksheet template (Figure 7) for tabulating municipal characteristics required for rate structure development.

Types of Rate Structures

There are several basic methods presented in the existing literature (see, for example, the EPA report *Funding Stormwater Programs* 2009): *Flat fees* per parcel, *Equivalent Residential Unit* (ERU), *Intensity of Development* (IOD), and the *Equivalent Hydraulic Area* (EHA). In addition, combinations of these methods are possible, whereby one method is applied to one land-use type and another method is used for other land uses. Appendix A of this report summarizes basic methods for allocating rate structures, while the Sacramento State EFC website (http://www.efc.csus.edu) offers additional resources to help understand details for each method.

No one method for a stormwater fee is correct. Communities in the US EPA Region 9 territory have used variations of all these methods to adopt fees. For instance, in Culver City, CA, residents approved a municipal stormwater fee that is a flat annual rate for each property. As another example, in the City of Sacramento, CA, properties are assessed a charge for drainage services based on building or lot size and land use type. For Sacramento residences, monthly fees are assigned according to the number of rooms in a household, which is readily available through tax assessor records and aligns with how the local water supply utility traditionally charged for water. Non-residential properties are assessed per unit of area (square-foot). These are examples of simpler methods for devising stormwater fees, which can be easier for utilities to implement and communicate to the public during the approval process.

In providing technical assistance to communities, EFC staff discusses options with municipal managers and helped assess the best type of rate structure based on data availability, political feasibility, and management requirements.

Example: Applying the ERU Method for Stormwater Parcel Taxes

Sacramento State EFC projects to date have used versions of the ERU and EHA methods. In 2009, the EPA estimated that ERUs were implemented by more than 80% of stormwater utilities (EPA 2009). The main advantage of the ERU method is its simplicity to implement and explain to the public. However, the ERU method does not equally distribute the costs of managing stormwater across properties with more impervious surface area than the average; property owners with greater impervious area may pay the same amount as a property owner with less impervious surface area. The ERU method also does not take into account runoff from pervious areas. Although pervious surfaces often have lower runoff impacts than impervious ones, pervious areas still contribute some degree of runoff and pollutants. The ERU method results in billing each customer based on impervious area using a procedure such as:

1. A representative sample of buildings in the utility's service area is reviewed to determine the average impervious area of a parcel, which represents one ERU. Traditionally, the ERU has focused on residential buildings, but average imperviousness could be assessed for various other land use categories (e.g., commercial and industrial), which could better align fee assessments with contributing properties.
2. The ERU is assigned a dollar amount based on the CPH calculated during the APA. If the CPH had a low RI, it is likely the project team will price one ERU equal to the CPH. If there is concern about the financial impact this will have, a fraction of the CPH can be applied.
3. Once an ERU target is established, it can be adapted to meet the needs of a community. For instance, larger residences, multi-family residences and apartment buildings, and commercial and industrial properties could be assessed separately to reflect how a community views the contribution of these properties to stormwater runoff. Commercial and industrial properties could even be assessed on a parcel-specific basis, as there are often fewer of these types of properties. Such approaches can help create equitable rate structures and potentially reduce

financial impacts on lower income households as part of credits and low-income assistance accommodations that are built into the rate structure (discussed below).

For large single-family residences, the impervious area of their parcel can be converted to an equivalent amount of ERUs by dividing the total impervious area by the ERU. This requires more initial work than assigning all single-family residences a single fee, but also allows for increased revenue and makes the fee system easier for the public to understand, as the fees are directly related to the amount of stormwater generated. Commercial and industrial properties can be addressed similarly to large residences. The impervious area of the commercial parcel can be converted to ERUs and charged accordingly.

To streamline the billing process and make the rate structure easier to understand for the public, municipalities can decide to implement tiered rates. For example, if one ERU is calculated as 1,000 square feet (sf) of impervious area, a residential-tiered rate structure can be extrapolated by knowing the total lot size of a property, which is typically in assessor data. Assuming that the average imperviousness is consistent across residential lot sizes, the tiered rate could charge larger lots a higher fee through multiple ERU tiers as follows:

- 1 ERU: 0 sf ≤ Impervious area ≤ 1,250
- 2 ERUs: 1,250 sf < Impervious area ≤ 3,000 sf
- 3 ERUs: 3,000 sf < Impervious area ≤ 6,000 sf
- 4 ERUs: 6,000 sf < Impervious area

This tiered approach can be employed to all properties, or refined to include land use type-specific values.

Gathering, Integrating, and Analyzing Data

Assessing fiscal impact means collecting data from many sources and estimating impacts for various rate structures. More complex methods require more data collection. In particular, developing a municipal stormwater fee that is based on actual property conditions requires understanding characteristics of impervious surface cover within a municipality. Impervious surface cover can either be estimated for each property, or statistical analysis can estimate the average percentage of cover across parcels. These are used to develop a rate structure, where properties are assessed a unit charge per square footage of surface cover based on property-level estimates or average values across land use types.

As noted, it is often easier to assign rate schedules based on assessments of average imperviousness across property types. This requires estimating imperviousness for only a sample set of properties, a much easier task. In developing ERUs to date, the Sacramento State EFC has used this approach, which is described below.

1. Collect geospatial data for parcel boundaries, municipal territories, and land use: The first step is to collect spatial data that supports an analysis of land use distribution in the region looking to enact a stormwater (or other) fee. Municipalities typically have the necessary land use and municipal boundary data, specifically the land uses for each parcel and estimates of lot sizes. Using this data, one can calculate descriptive statistics of land use and lot size broken down by categories such as single-family residential, multi-family residential, commercial, and industrial. In some cases, the local tax assessor's database may be available, which gives additional building

and property characteristics. The analysis provides a comparative metric for evaluating the validity of derived sample sets.

2. Acquire US Census data for estimating MHI: MHI is an important consideration in assessing the affordability of any fees. The best source of this data is the US Census. Census data from the 2014 American Community Survey (ACS) at the block group level (most recent with high-resolution) can be downloaded for California and, if capacity exists, joined to geospatial shape files of block groups. The ACS data reports MHI along with MHI brackets such as 0-10% of the population, 10-20%, etc. For communities assisted by the Sacramento State EFC, the reported average MHI values for each block group in the respective service territory were mapped. Then, the MHI data from the associated block group was joined to the collection of properties located within the block group, yielding a more detailed assessment of MHI. This allowed for assessing distributions of MHI across properties to the highest level of spatial resolution possible.
3. Analyze geographic dispersion of income, land use, and lot size: The next step is to develop statistical distributions and categorical breakdowns of property characteristics in the service territory. These include analysis by land use and lot size as noted above, along with MHI. Additionally, categorical statistics for multiple criteria such as land use distribution by MHI and lot size by land use type are estimated.
4. Develop a sample set of properties that resemble statistical distributions: To estimate average impervious cover by land use, a representative sample set is needed. The Sacramento State EFC tested several methods, including using a spatially randomized selection of properties and other methods. The chosen method involved selecting properties with a street address ending in the number "1", as it yielded a useful sample that reasonably resembled property-level distributions. The approach constituted approximately a 10% sample of properties in a municipality. For instance, in Paso Robles, which has nearly 12,000 properties, approximately 1,000 properties have street addresses that end in the number "1". The data for these properties was extracted and exported for further analysis.
5. Assess impervious surface cover statistics for the sample set of properties: With a sample set assembled, *Google Earth* and *Google Street View* imagery can be used to assess impervious surface cover for each property in the sample sets. *Google Earth* software provides an embedded tool for measuring area, which can be used to assess the area of rooftops, sidewalks, and driveways on a property. Once the full dataset was populated with property-level assessments of impervious surface area (in square-feet), this value was divided by the lot size reported in parcel data to yield the percentage of impervious surface cover. The average imperious surface cover across land use types was recorded, which fed into analysis tools currently under development for devising rate structures and assessing associated equity effects.

The Sacramento State EFC toolkit includes a *rate structure workbook* that allows municipal program managers to assemble and assess the data for developing rate structures. Further discussion on the workbook is provided in the *Identifying a Preferred Rate Structure* section below. Table 8 lists the various datasets that are needed for the entire Sacramento State EFC rate structure methodology, including property and census data as well as the asset inventory and cost estimates previously discussed above.

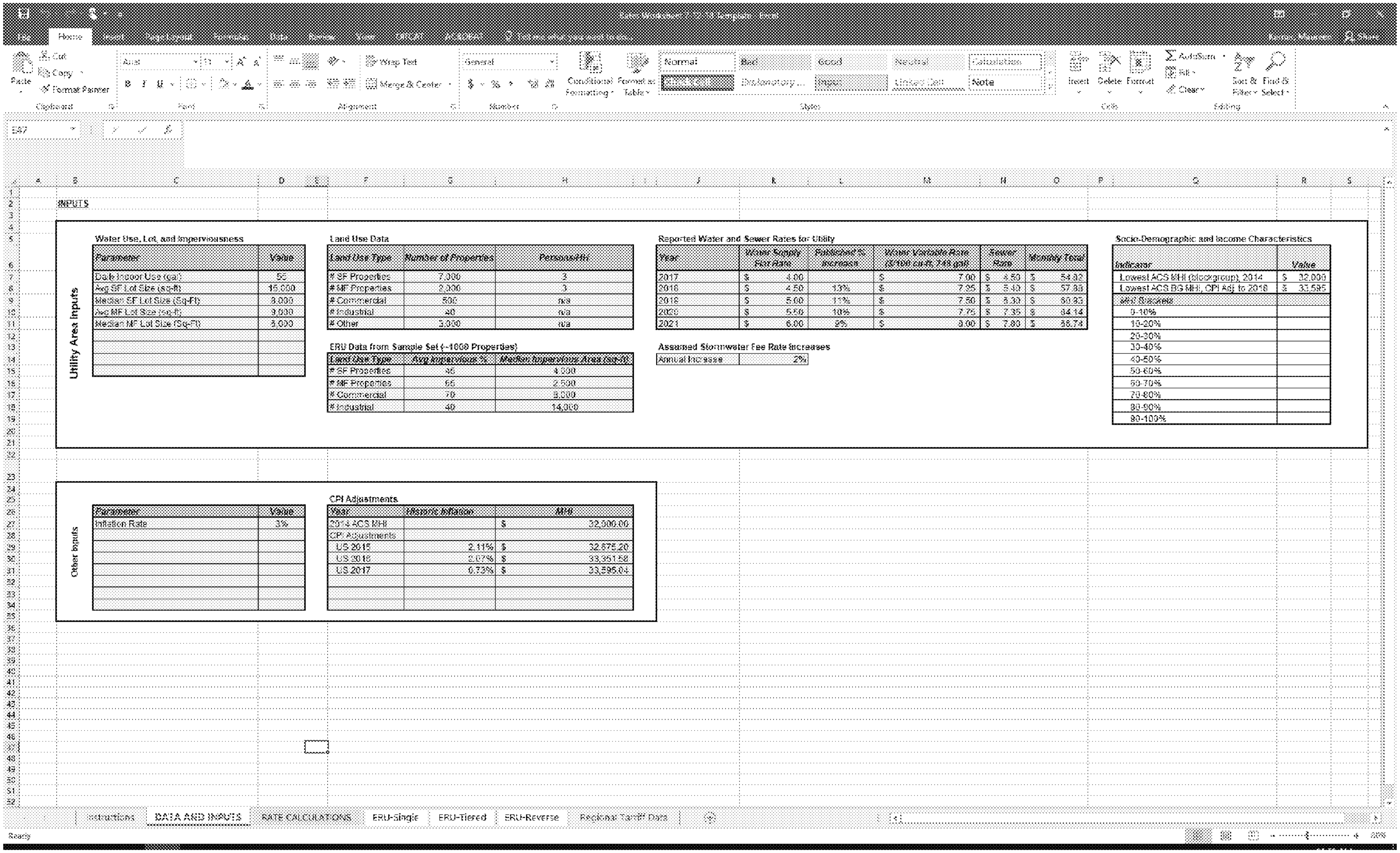

Figure 7. Screen Shot of the Sacramento State EFC Data and Inputs Worksheet for Developing a Rate Structure

The outlined procedures were followed in coordination with several California communities as part of Sacramento State EFC projects and are field-tested. However, such data analysis can be prohibitive for communities that are receiving technical assistance from consultants. To address this challenge, as of June 2018, the Sacramento State EFC began assessing the potential to create an open-source, statewide dataset with parcel-level assessments of impervious surface cover, which could support rate structures based on either parcel-specific assessments or the ERU methodology. That work is on-going, and the assessments of impervious surface cover in sample sets for each of the municipalities is serving as a training data set to assess the accuracy of automating methods to create statewide datasets.

Table 8: Datasets Needed for Asset Management and Rate Structure Development

Dataset	Description	Purpose
Asset inventory	Database of stormwater system assets & characteristics	Supports development of a plan for maintenance scheduling & renewal costs
Stormwater system & program costs	Unit & programmatic costs for stormwater management activities, including inspections, maintenance, & permit compliance requirements	Allows for estimating total costs that must be covered by the incoming revenue portfolio
Property boundaries & assessor data	Geospatial layer of parcel boundaries in the utility service area, & associated tax roll data for land use, lot size, & other characteristics	Supports analysis of imperviousness (average or per property) used to develop a rate structure
US Census block group data	American Community Survey data for socio-demographic and economic characteristics	Provides socio-economic information to assess affordability impacts of rates
Impervious surface cover	The percentage of impervious surface cover for various land use types properties	Used to calculate average or parcel-specific imperviousness required for several types of stormwater fees

Developing Low-Income Assistance Discounts and Credits

A variety of discounts and credits can be offered by municipalities. Discounts provide assistance to households based on financial need, while credit programs incentivize building owners to undertake infrastructure improvements on properties that reduce downstream requirements.

Low-income assistance programs offer relief to offset the costs of fees, charges, and taxes. They are targeted at households who experience a more significant impact of fees as a percentage of their income. As such, eligibility is usually tied to a total combined annual household income and number of household members. For instance, the California Water Services' low-income credit assistance program provides a discounted fee to households meeting income eligibility requirements (Figure 8). The income threshold increases with household size. Many credit programs across water and electric utilities have similar structures.

Figure 8: Example of a Low-Income Credit Program Eligibility Scale (Cal Water 2018)

Maximum Household Income (effective June 1, 2017 – May 31, 2018)	
To be eligible for LIRA, your household's gross annual income may not exceed:	
Household Size	**Total Combined Annual Income**
1-2	$32,920
3	$41,560
4	$50,200
5	$58,840

The credit that eligible households receive can take many forms (Table 9 provides some examples). For instance, credit options could be exemptions from certain charges, a decreased percentage of a fixed rate charge on a bill, or a lump-sum credit (monthly or annual) provided to households to offset the billed cost-of-services. Ratepayers typically submit supporting documentation, such as a prior-year tax return, to demonstrate eligibility.

Another perhaps easier option for providing income-based relief is to include a "zero-rate" style exemption. In this structure, a tier or specific type of customer or property is charged at a zero rate, or is essentially free. As an example, communities could choose to only assess commercial and industrial properties with stormwater fees, using the assumption that these properties disproportionately contribute to stormwater runoff. Utilities could also apply fees to all residents and properties, but have a lower tier whose zero charge attempts to reduce cost burdens for vulnerable populations while providing a baseline amount for health and safety. This is more often used in other sectors such as electricity or water supply, where there is an assumption of an inherent connection between the volume of consumption of a resource and income. Medium- and high-income households that consume more and the base amount needed for subsistence would pay more through the rate structure. The approach provides an easy-to-implement subsidy, though it may not be entirely applicable to stormwater. Table 9 compares zero-rate and income-based options for credits and discounts.

Utilities, however, must compensate for the revenue lost by low-income assistance programs. They can accomplish this by raising fees in other rate tiers or including a fixed charge for low-income assistance. One innovative mechanism is to have an opt-in program, where ratepayers contribute to the fund voluntarily. As an example, utilities in North Carolina use a "round up" opt-in program to support a low-income assistance fund. The program provides rate payers an opportunity to round up their bills to the nearest dollar, with the balance between the billed amount and the collected amount going into the assistance fund.

Many communities offer credits to rate payers for stormwater management-related activities that are not income-based. For example, a residence with disconnected roof downspouts could receive a 25% discount on their fee. The installation of a properly constructed rain garden could reduce the fee by a percentage equivalent to the estimated percent capture based on its size. Other actions to reduce impervious surface cover and connections to runoff infrastructure, especially on properties with significant areas of imperviousness, can be included for one-time or continual discounts. Total discounts should be limited to something less than 100% of the total fee, however, as NPDES compliance costs will exist even if all properties demonstrate 100% containment of stormwater.

Table 9: Categories of Income-Based Assistance for Ratepayers

Option	Summary	Advantages	Disadvantages	Notes
Zero-rate	No residential unit is charged for Stormwater Fees, regardless of income or household size. Higher tiers will be charged a positive rate. Benefits inversely proportional to income.	Money not required for administration, public outreach, or law enforcement for residential eligibility. Easier to calculate and forecast revenue from commercial and industrial properties.	Would not proportionally benefit low income households with respect to household size. Non-residential units would pay full amount. May not generate sufficient revenue. Residents do use public infrastructure (roads) that contribute to stormwater runoff, but in this instance would not pay for it.	Fees focus on commercial and industrial properties, assuming these properties are the greatest contributors to contamination
Zero-rate tier	In a tiered stormwater fee rate structure, include a bottom tier, for instance up to 1,000 sq-ft of area, assessed at a zero rate. Assumes that lower-income households would have smaller properties. This could potentially be tailored to a specific community, by implementing it in only low-income areas based on localized data.	May be easier to implement for utilities, allows an across-the-board credit that would be especially helpful to lower-income residents with small or no property.	Would not allocate assistance appropriately if low-income residents had larger properties.	This approach is more common in sectors where consumers are charged for consumption, such as electricity or water supply.
Income Based Exemption or Credit	Ratepayers demonstrate eligibility and apply to program. Post-review and approval, lower bills or end-of-year credit is given to the ratepayer.	Targets relief to low income ratepayers, accounts for household size, and scales benefits for income level.	Requires resources to manage program and spread program awareness to low income audience. Commit legal department to deal with appeals for applications. Delays in document processing. Would need annual applications to account for fluctuating annual income. Potentially less political support.	Eligibility options: already being enrolled in a low income credit assistance program, and not exceeding gross annual income bracket per household size.

Identifying a Preferred Rate Structure

The process of identifying a set of promising rate structures is iterative. Ideally, generated revenue would cover total costs. When it does not, alternative funding sources need to be identified.

The enacting governing body, such as a city council or county board of supervisors, must ultimately decide if a proposed tax or assessment structure is fair and appropriate. Comparisons with nearby communities can help gauge the feasibility of a rate structure.

The Sacramento State EFC surveyed some local examples of existing stormwater fee and assessment structures for California. Results are available through the stormwater funding portal from the California Stormwater Quality Association (CASQA).[2] Additionally, Western Kentucky University regularly publishes a comprehensive survey of existing stormwater fees from across the US, providing background information on rate structure approaches and a detailed appendix of historic stormwater fees (Campbell 2016). Finally, assessments of political feasibility also require public input. In some communities, voters directly approve municipal revenue-generating proposals, so any rate structure must be capable of gaining support. All of these considerations must be taken into account when selecting one or more preferred rate structures.

The Sacramento State EFC toolkit supports the iterative process of identifying viable rate structures. After collecting and analyzing the relevant information on community characteristics and existing infrastructure, the *rate structure workbook* (Figure 9) allows a user to input varying fee amounts and assess the associated amount of revenue that could be generated, or use the opposite procedure to derive rates from a preferred amount of total revenue. The estimated program costs for permit compliance, existing management, and future buildouts can be directly compared to revenue estimates from the rate structure workbook, providing a basis for discussion among utility managers and municipal leaders regarding expectations for the stormwater program.

[2] Table of existing stormwater fees and taxes in California is located at CASQA's Stormwater Funding Portal: https://www.casqa.org/sites/default/files/downloads/06_sw_program_rates_master_list_allprogramsbycounty_20181008_sci.pdf

RATES ANALYSIS: Based on an Equivalent Residential Unit of Imperviousness (Single Rate)
6/27/2018

CSUS Office of Water Programs
Environmental Finance Center

ERU Structure

Tiers (Changes by Property Type)	# of SF Properties	# of MF Properties	Commercial	Industrial
1 ERU	4000	700	700	5
2 ERUs	2000	800	200	1
3 ERUs	1000	300	500	25

PROGRAM REVENUE PROJECTIONS*

	Year	1	2	3	4	5	
Residential	Estimated Charge (based on 55 gpd indoor, sewer)	$ 54.82	$ 57.88	$ 60.93	$ 64.14	$ 66.74	
	Stormwater Tariff (1 ERU)	$ 2.15	$ 2.19	$ 2.24	$ 2.28	$ 2.33	<< Input Decision Variable
	Monthly Bill Estimate (w/ reported rate increases)	$ 56.97	$ 60.07	$ 63.17	$ 66.42	$ 69.07	
	Annual Bill Estimate (w/ reported rate increases)	$ 684	$ 721	$ 758	$ 797	$ 829	
	Subtotal: Revenues from SF Properties	$ 283,800	$ 289,476	$ 295,266	$ 301,171	$ 307,194	
	Subtotal: Revenues from MF Properties	$ 82,560	$ 84,211	$ 85,895	$ 87,613	$ 89,366	
Commercial & Mixed Use	*Subtotal: Revenues from Comm-MU Properties*	$ 67,080	$ 68,422	$ 69,790	$ 71,186	$ 72,610	
Industrial	*Subtotal: Revenues from Industrial Properties*	$ 2,116	$ 2,158	$ 2,201	$ 2,245	$ 2,290	
TOTALS	STORMWATER PROGRAM REVENUE	$ 435,556	$ 444,267	$ 453,152	$ 462,215	$ 471,459	

TOTALS ACROSS ERU CATEGORIES

	Year	1	2	3	4	5
SF Residential	Subtotal: ERU Tier 1	$ 103,200.00	$ 105,264.00	$ 107,369.28	$ 109,516.67	$ 111,707.00
	Subtotal: ERU Tier 2	$ 103,200.00	$ 105,264.00	$ 107,369.28	$ 109,516.67	$ 111,707.00
	Subtotal: ERU Tier 3	$ 77,400.00	$ 78,948.00	$ 80,526.96	$ 82,137.50	$ 83,780.25
MF Residential	Subtotal: ERU Tier 1	$ 18,060.00	$ 18,421.20	$ 18,789.62	$ 19,165.42	$ 19,548.72
	Subtotal: ERU Tier 2	$ 41,280.00	$ 42,105.60	$ 42,947.71	$ 43,806.67	$ 44,682.80
	Subtotal: ERU Tier 3	$ 23,220.00	$ 23,684.40	$ 24,158.09	$ 24,641.25	$ 25,134.07
Commercial & Mixed Use	Subtotal: ERU Tier 1	$ 18,060.00	$ 18,421.20	$ 18,789.62	$ 19,165.42	$ 19,548.72
	Subtotal: ERU Tier 2	$ 10,320.00	$ 10,526.40	$ 10,736.93	$ 10,951.67	$ 11,170.70
	Subtotal: ERU Tier 3	$ 38,700.00	$ 39,474.00	$ 40,263.48	$ 41,068.75	$ 41,890.12
Industrial	Subtotal: ERU Tier 1	$ 129.00	$ 131.58	$ 134.21	$ 136.90	$ 139.63
	Subtotal: ERU Tier 2	$ 51.60	$ 52.63	$ 53.68	$ 54.76	$ 55.85
	Subtotal: ERU Tier 3	$ 1,935.00	$ 1,973.70	$ 2,013.17	$ 2,053.44	$ 2,094.51
TOTALS	Total revenue (should match above)	$ 435,556	$ 444,267	$ 453,152	$ 462,216	$ 471,459

HOUSEHOLD AFFORDABILITY**

	Analysis of Household Affordability					
Blockgroup with Lowest MHI (Most Vulnerable)	*Associated MHI Threshold for Total Monthly Bill*					
	1%	$ 68,368.24	$ 72,085.13	$ 75,803.06	$ 79,702.03	$ 82,882.09
	2%	$ 34,184.12	$ 36,042.56	$ 37,901.53	$ 39,851.02	$ 41,441.04
	Annual Expense of 2018-Adjusted MHI Threshold ($35,432)					
	1%	$ 346.03	$ 356.11	$ 366.19	$ 376.26	$ 386.34
	2%	$ 692.06	$ 712.21	$ 732.37	$ 752.53	$ 772.69
	Disparity					
	1%	$ 337.65	$ 364.74	$ 391.84	$ 420.76	$ 442.48
	2%	n/a	$ 8.64	$ 25.66	$ 44.49	$ 56.13

* Based on nominal costs (in that year) of rates using published rate increases and no additional inflation considerations
** Based on nominal values of Median Household Income values in each year using 3% inflation rate

Figure 9. Screen Shot of the Sacramento State EFC Rate Structure Worksheet